



Designing TTM studies: examples from the UK

Samantha Jamson

Should I walk on there?



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Designed by a mathematician?



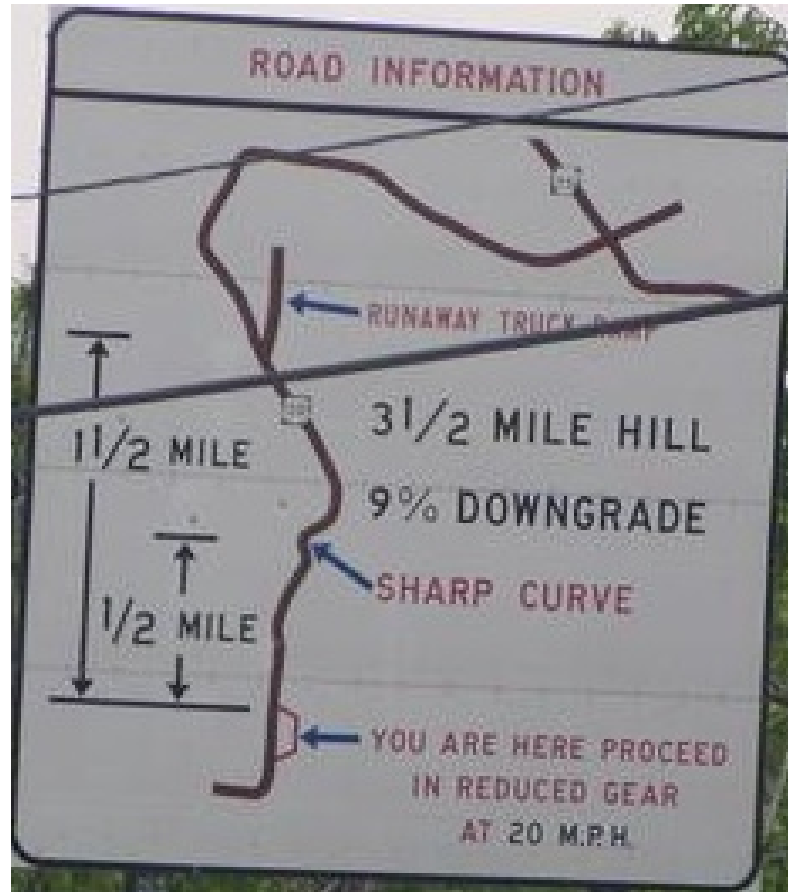
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Customers want information



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Eyes in the back of your head!



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- Not widely reported or studied, due to difficulty in attributing their contribution to an event accurately
- However, in 2011 there were 1,703 accidents in roadworks, of which 579 accidents had the contributory factor “Failed to Look”.
- Four resulted in fatalities and 53 resulted in serious injuries.
- A total of 244 accidents were associated with the contributory factor “Temporary road layout (eg. contraflow)”.

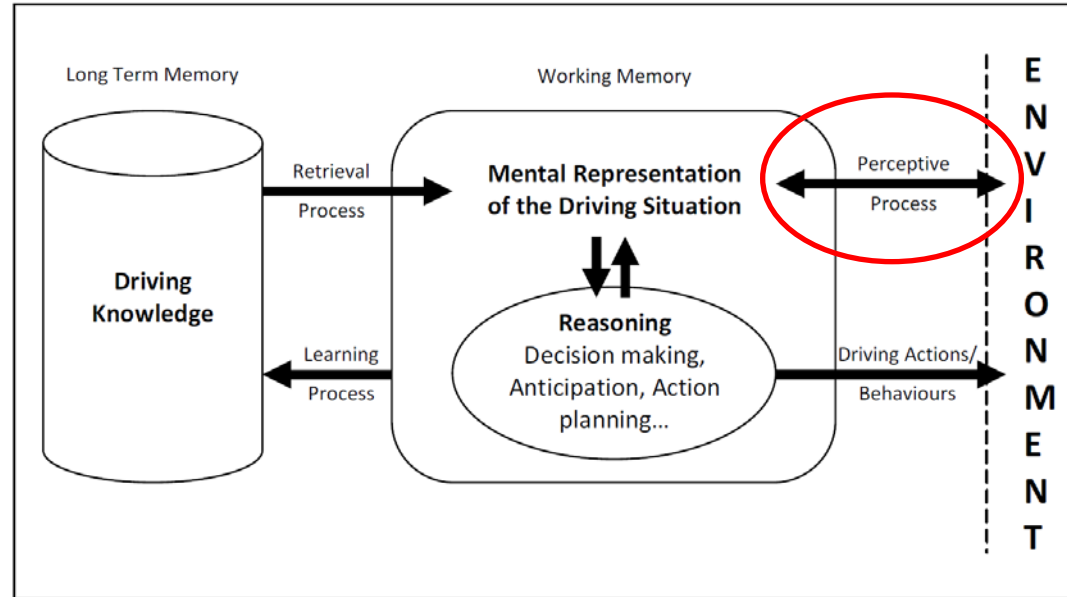
- Anxiety/anger at roadworks and sign comprehension
- Reducing sign size



- Human resources are finite, not all of the available roadside information can be processed dynamically
- On the approach to roadworks, drivers have a number of visual and mental tasks to perform.
- The monitoring and maintenance of appropriate speed/position as well as monitoring other users' actions takes precedence, often at the expense of sign comprehension
- Therefore signs should not present themselves as “additional things to process”

How to improve comprehension?

- The volume of information and the associated processing requirements, means drivers make decisions and act in uncertainty
- It is the perceptive process of signing which is the focus of our studies.
- It is hoped that this will improve the comprehension of traffic management signs.
- Ultimately we wish to influence drivers' mental representation of TTM signs.





Do drivers comprehend?

- Comprehension has been shown to range from 17% for a pedestrian warning sign to 78% for a speed limit sign.
- However, DfT (2011) reported high levels of sign comprehension when drivers were asked to explain the meaning of signs which were displayed with environmental context.
- Signs which attract a high level of enforcement, or those which are encountered frequently are the most well known.
- The way in which a message is presented is important: obligatory signs are better understood than prohibitive ones.

Improving comprehension



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- Standardisation of colour and layout is key.
- Signs within roadworks in the UK have a yellow background with black borders and features.
- Stereotypes can be incorporated to reinforce messages, for example the colour 'Red' is used to indicate prohibition, warning or danger
- Increasing adherence to ergonomic principles can also improve comprehension.



- The understanding of signs is regarded as the most important design factor for traffic signs (Dewar, 1988).
- Other criteria such as conspicuity, reaction time and legibility distance are of less importance
- Signs that are not understood fail to convey their message and can lead to confusion type errors, divert attention away from driving (Ward et al., 2004), and possibly result in RTIs (Underwood et al., 2002a).
- Drivers have to perceive the sign, in order to have any chance of comprehending
- Perception is influenced by one's state of mind



Emotion and driving – key research

- Parkinson (2001) found that anger is more likely to occur in driving situations compared to any other context.
- Underwood (1999) showed that drivers become angry in approximately 20% of all journeys.
- Arnett (1997) found that anger led to speeding
- Mesken reported that anger was mostly associated with situations where an “other” was to blame, whilst anxiety occurred where the “situation” was to blame.
- Anger is mostly associated with events affecting impeded progress, and anxiety with events affecting safety.
- Sullman (2007) reported that the most anger-invoking scenarios were those where “someone cuts in right in front of you on the motorway”.



Investigating anger and anxiety at roadworks

Samantha Jamson

With support from WSP
and the Highways Agency

Research aims

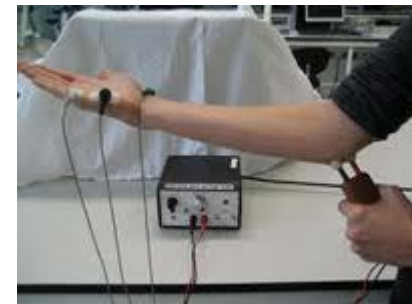
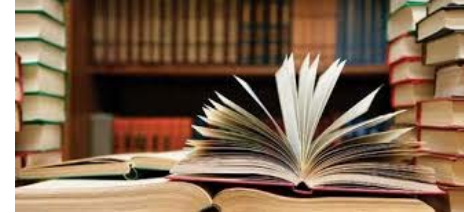


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- To establish which roadwork scenarios cause anger or anxiety to drivers
- To develop and test solutions to reduce these negative emotions in a driving simulator
- To produce recommendations for the highway authority

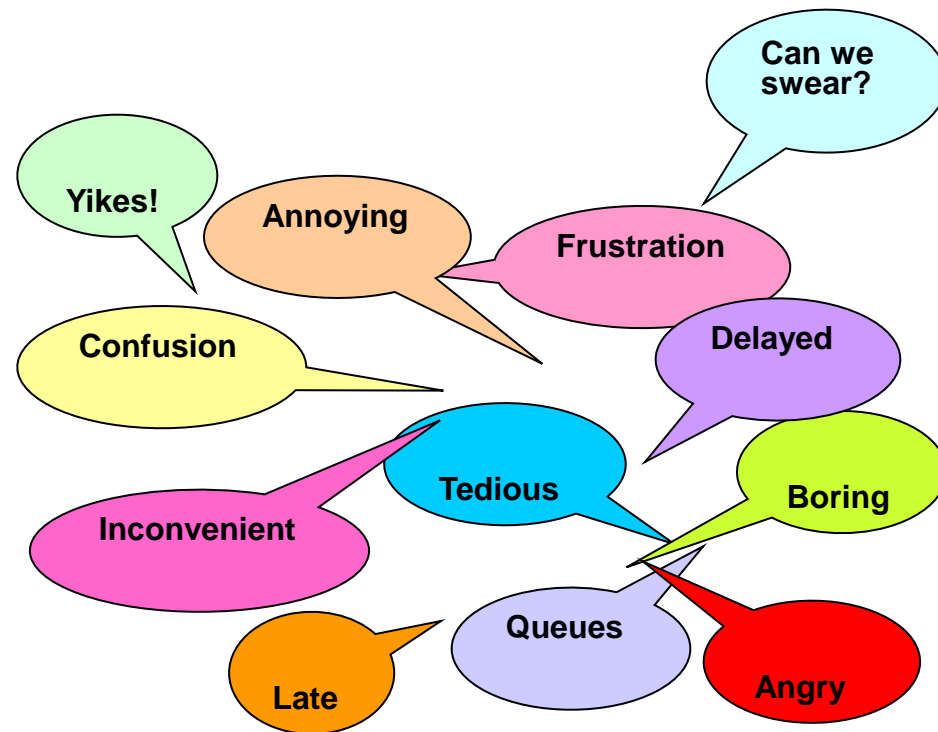


- Desktop review of appropriate literature
- Qualitative research - discussions with drivers
- Laboratory based trial
- Driving simulator experiments, incorporating behavioural and emotional measures



- Two (single gender) discussion groups with a moderator, using a predefined topic guide
- Aim - to probe the situations where drivers perceive most problems when driving through roadworks.
- We also elicited their views on how to improve the situation and what information should be available to drivers.

Q Provide one word that generally describes your experience of roadworks



Popular responses



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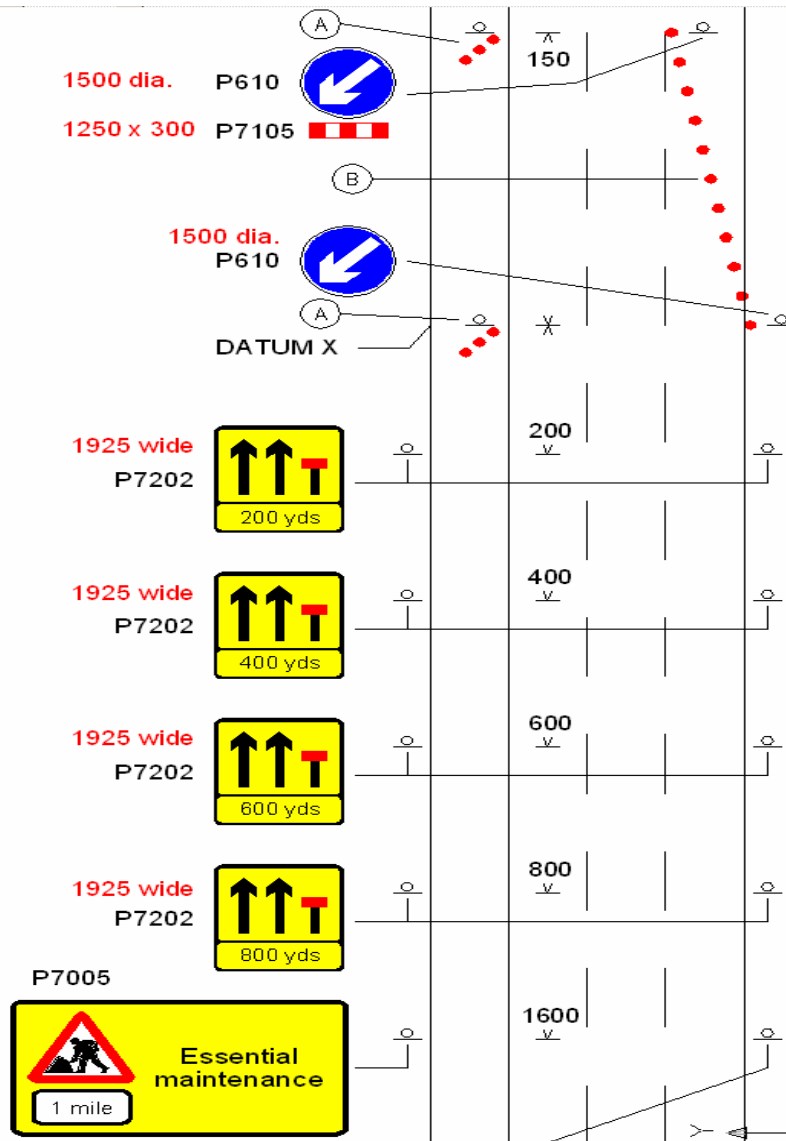
Code List	Text segments per Code		
	Male	Female	Total
Coping Strategies and Behaviour: Solutions	6	1	7
Effects: Behaviour of Other Drivers	10	4	14
Effects: Safety and Risk	7	7	14
Effects: Pressure, Stress, Frustration, Fatigue, Fear or Anger	18	9	27
Effects: Relations With HGVs and Other Transport	2	1	3
Information: problems with signs used	9	5	14
Information: type of information wanted	9	7	16
Types: Scenario 1: Lane Drop In 800 Yards	4	3	7
Scenario 2: 25% Narrow Lanes	2	1	3
Types: Scenario 3: 2 Lane Contra Flow	2	2	4
Types: Ghost-Works	2	3	5
Types: Most Disliked	5	1	6
Perceptions Of HA and Policy Recommendations	30	10	40

Results – anger/anxiety inducing scenarios

Lane drop

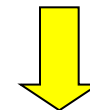


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Group A believed it was OK to use Lane 3 until close to the start of the cones. They believed their behaviour maintained good traffic flow.

Group B thought best practice was to move into Lane 2 as soon as they could. They believed their behaviour to be safety-conscious.



“other drivers” are the problem

Results – anger/anxiety inducing scenarios

Narrow lanes

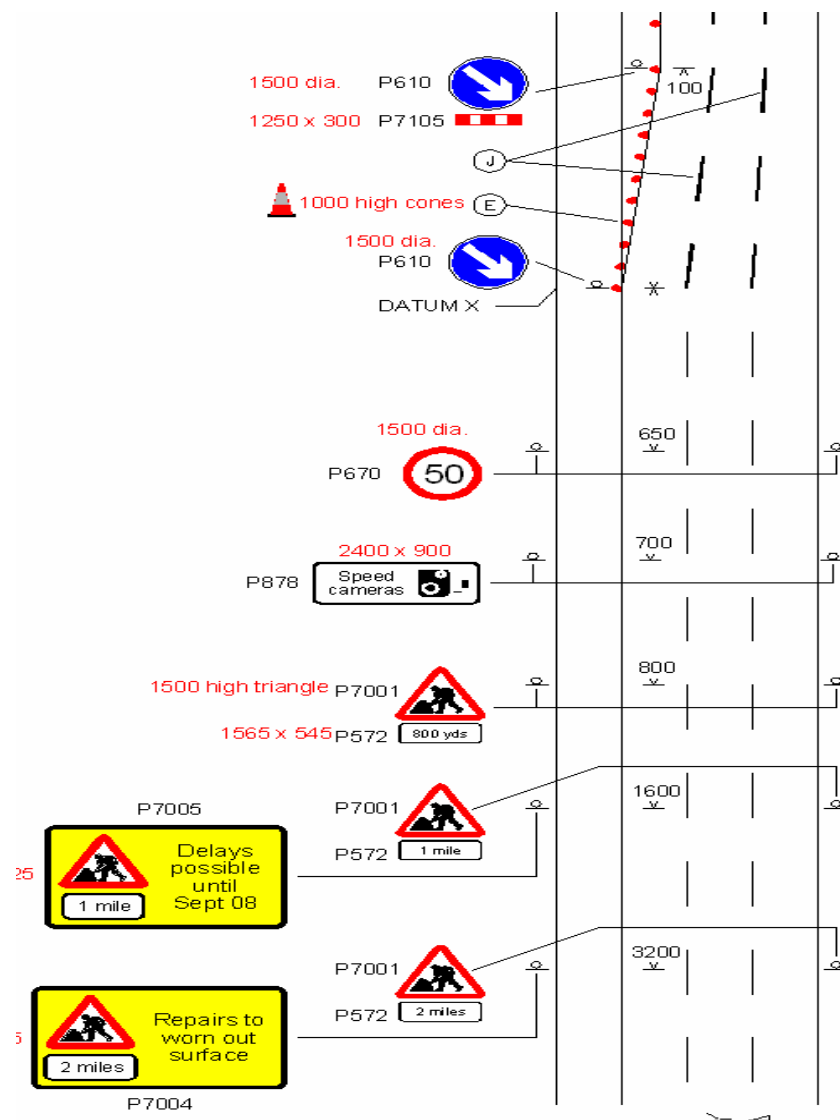


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Most problems due to presence of HGVs and anxieties experienced when having to overtake them

Drivers prefer to travel in Lane 3 to try and avoid travelling alongside HGVs.

Drivers also mentioned (in all scenarios) that it was annoying when roadworks were “empty” with apparently no work going on.

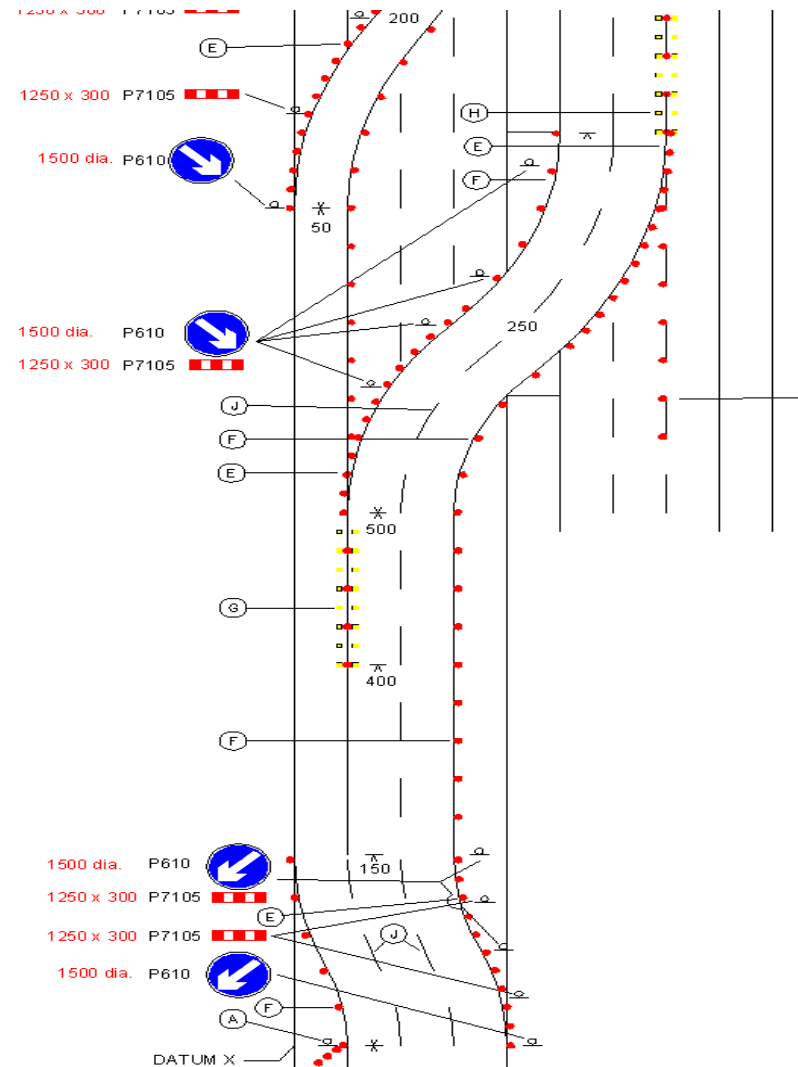
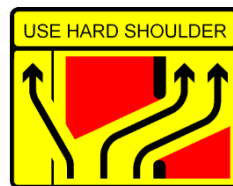
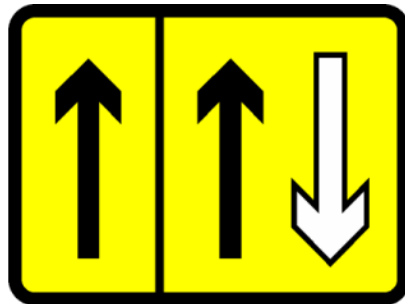


Results – anger/anxiety inducing scenarios

Contraflow



Drivers mentioned that the large amount of signage is confusing, particularly where they were required to exit the motorway.

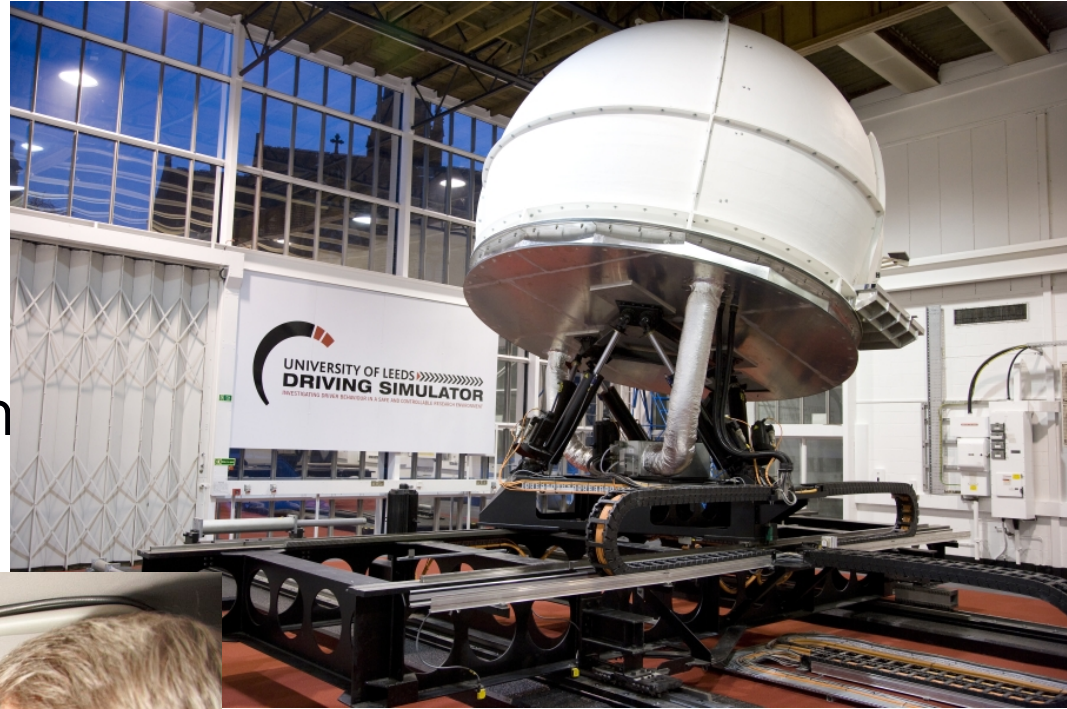


Driving simulator trials – collecting objective data



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- To establish if the three roadworks scenarios induced anger or anxiety
- To investigate the effects of anger and/or anxiety on driving behaviour



- To test ways of reducing these effects by improving signage.

<http://www.youtube.com/watch?v=3wFJ5iFmUw&feature=youtu.be>

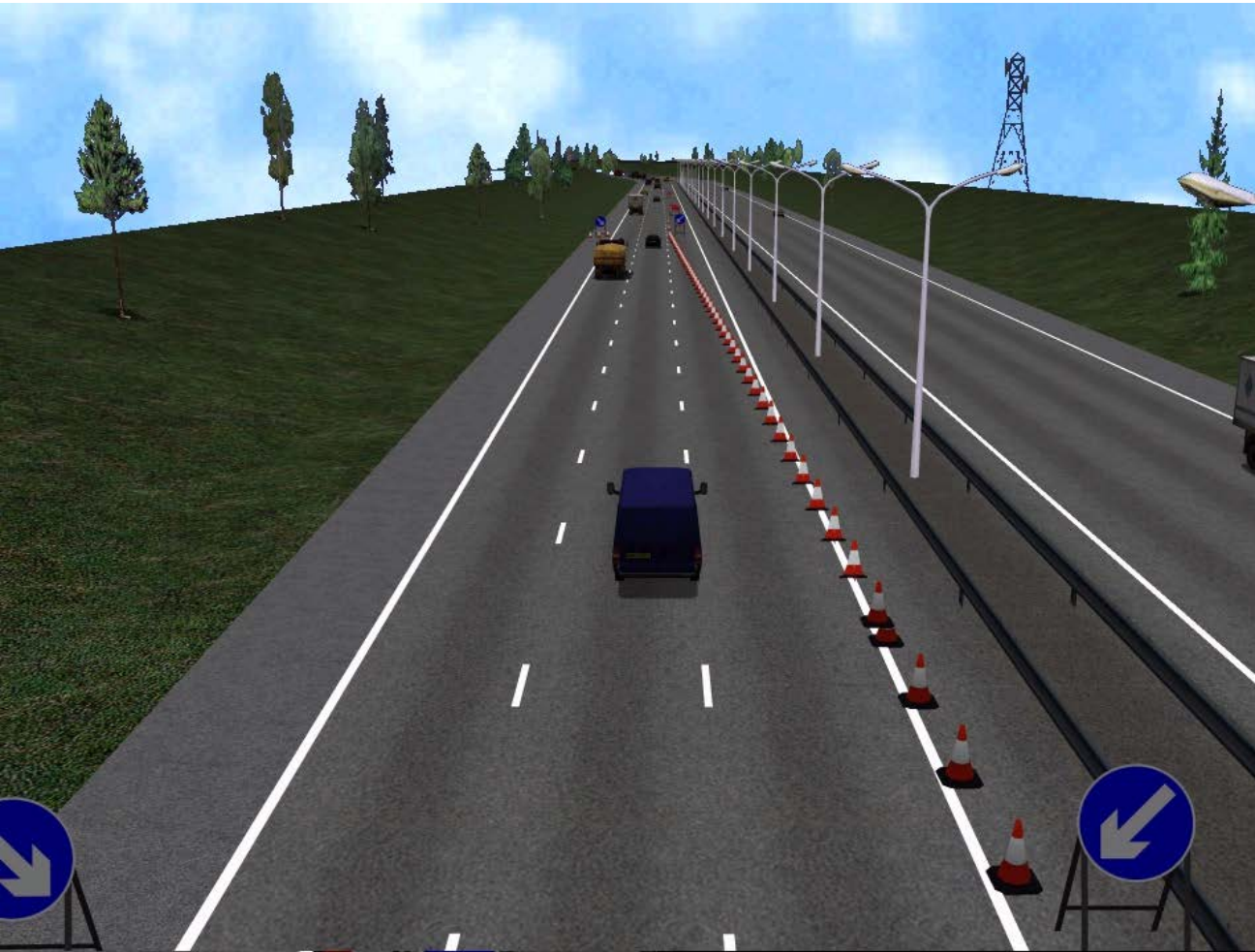


- The virtual driving scenario consisted of a typical U.K. motorway with standard lane widths, markings and junction layouts
- Road signs were modelled to real-life size, using textures imported from the actual signs
- Forty participants were recruited, each encountered all three roadworks scenarios (baseline and experimental conditions)
- Consisted of 2 thirty minute drives.

Lane drop scenario



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Antagonist vehicles



if anger is evoked
and how long the
effects last



New signage

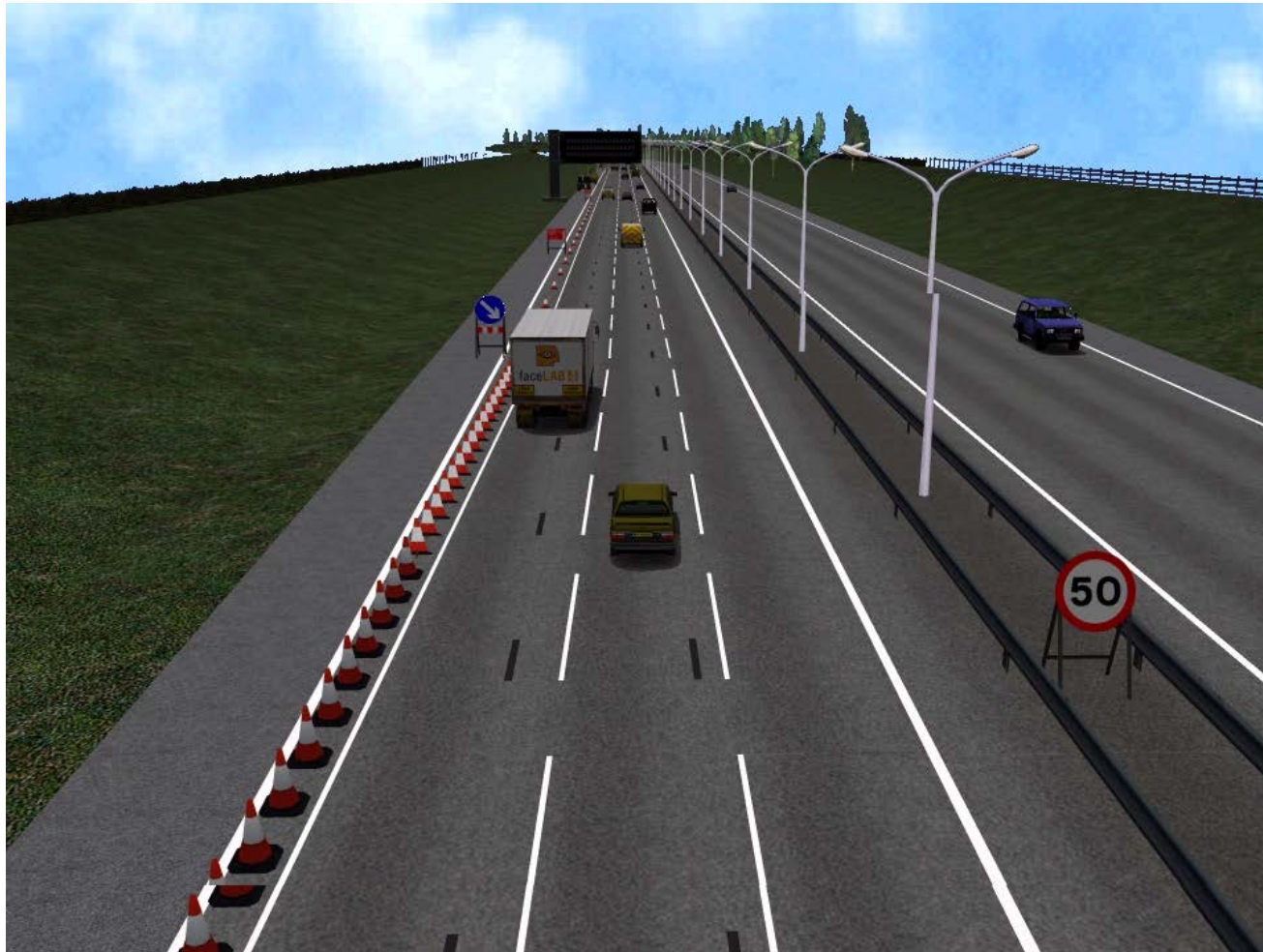


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Narrow Lanes scenario



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antagonist
vehicle (HGV)

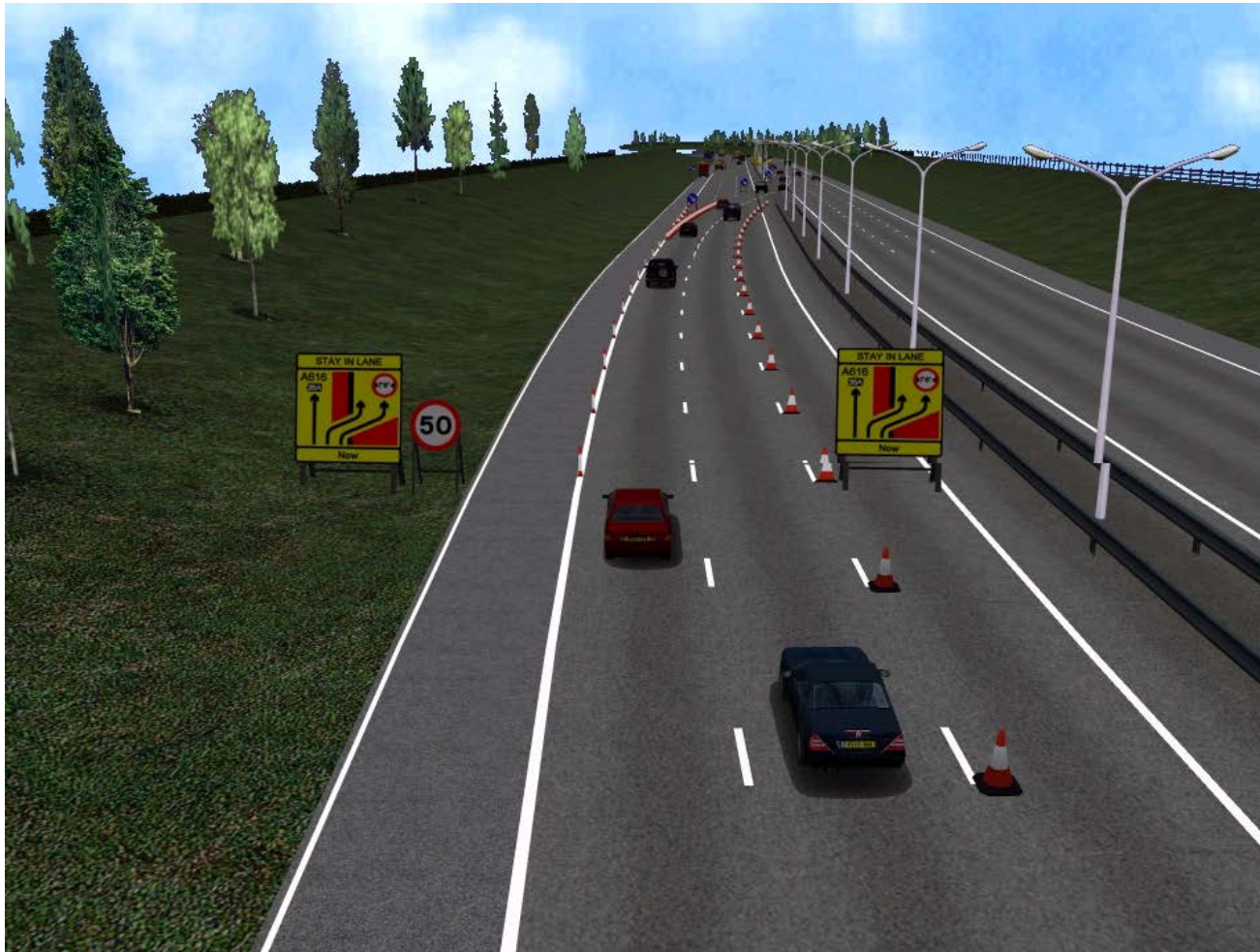


if anxiety is evoked and how long the effects last

Contraflow scenario



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Main problem is information clutter but lack of advance warning



New signage
“Use Hard shoulder ahead”



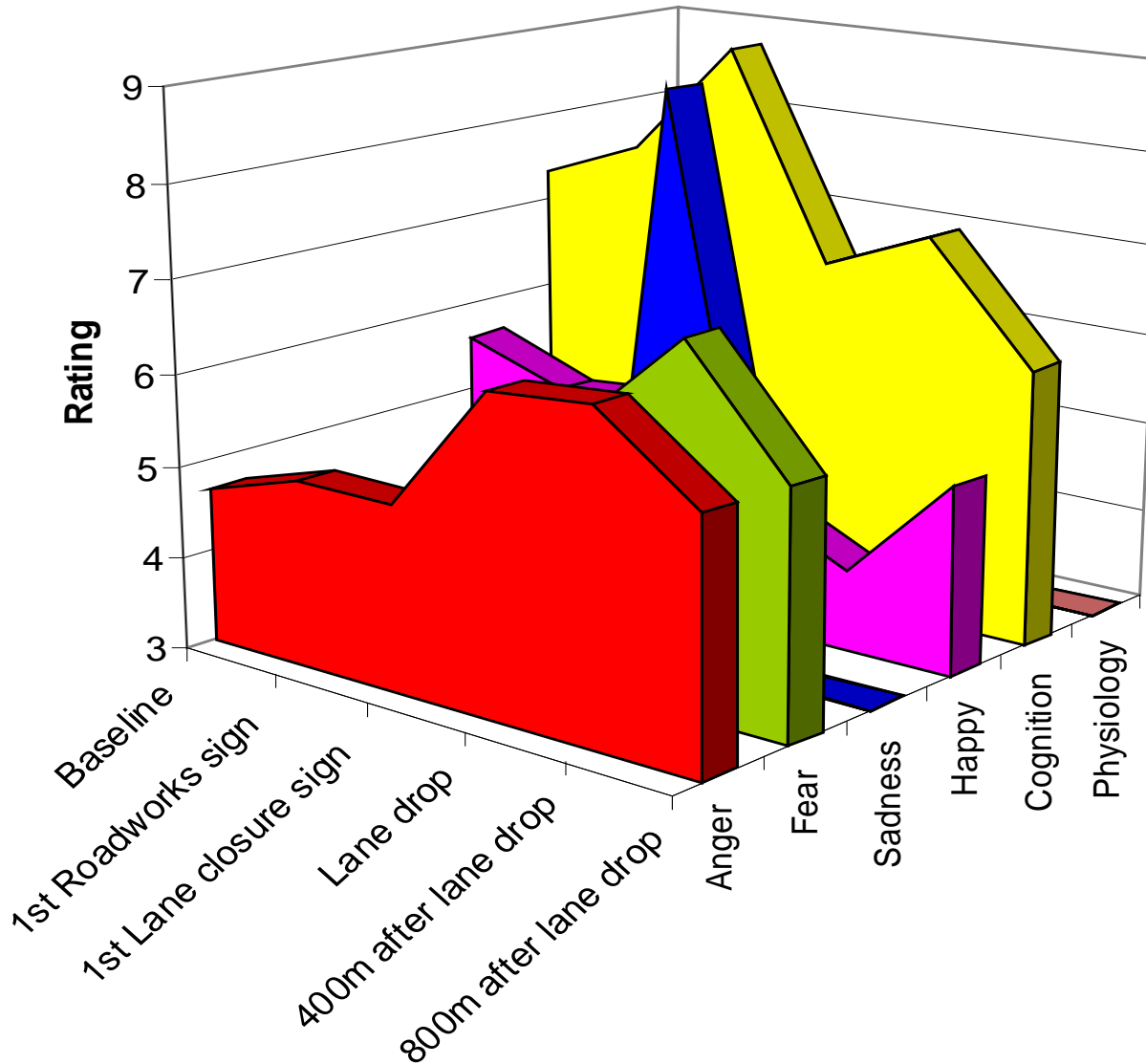
Results -a reminder.....

- Can we invoke feelings of anger and anxiety at roadworks in a driving simulator?
- Do these emotions impact on driving behaviour
- Can we reduce these emotions using simple engineering (signage) measures?

Reported emotions – lane drop



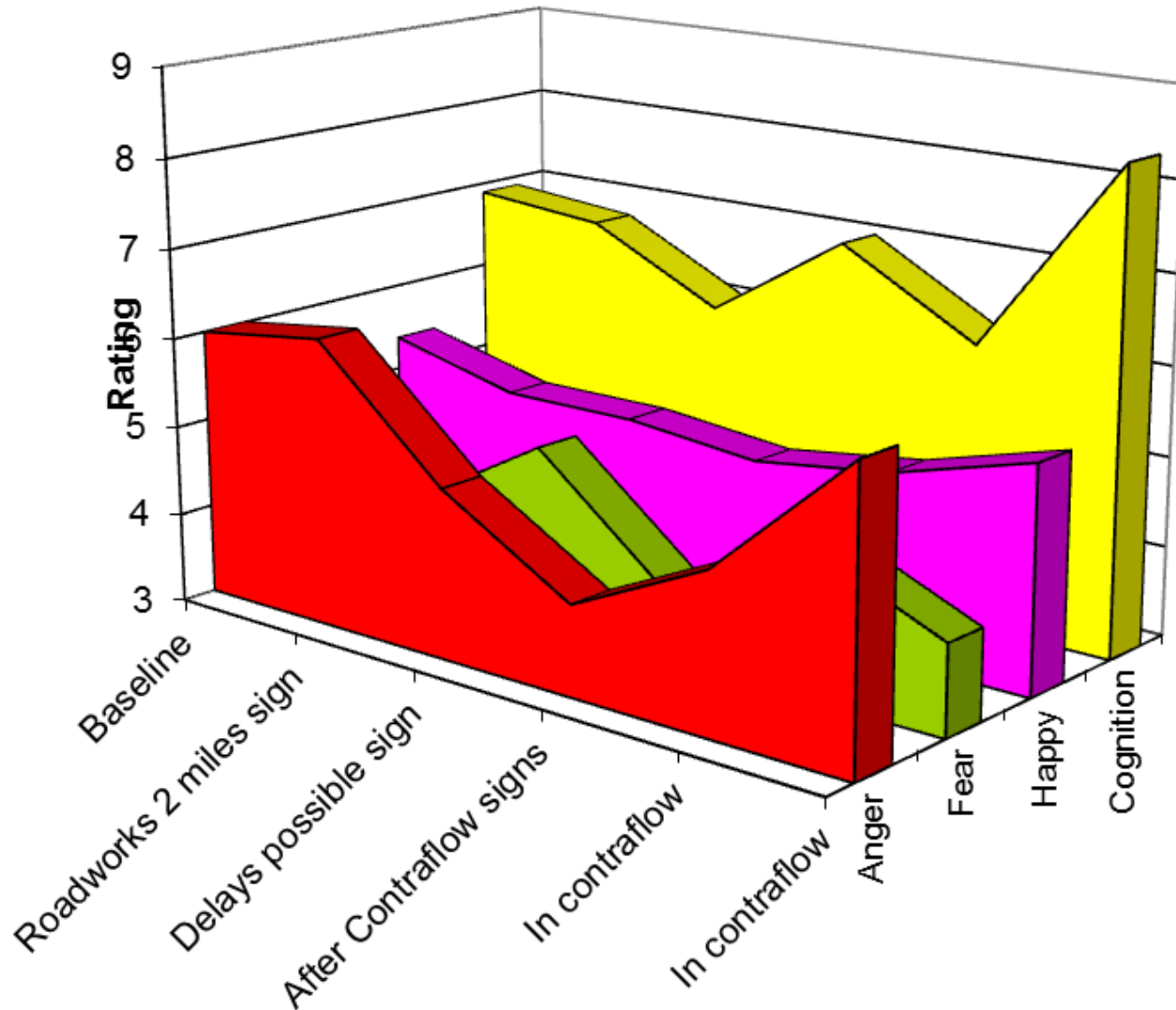
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Reported emotions – contraflow



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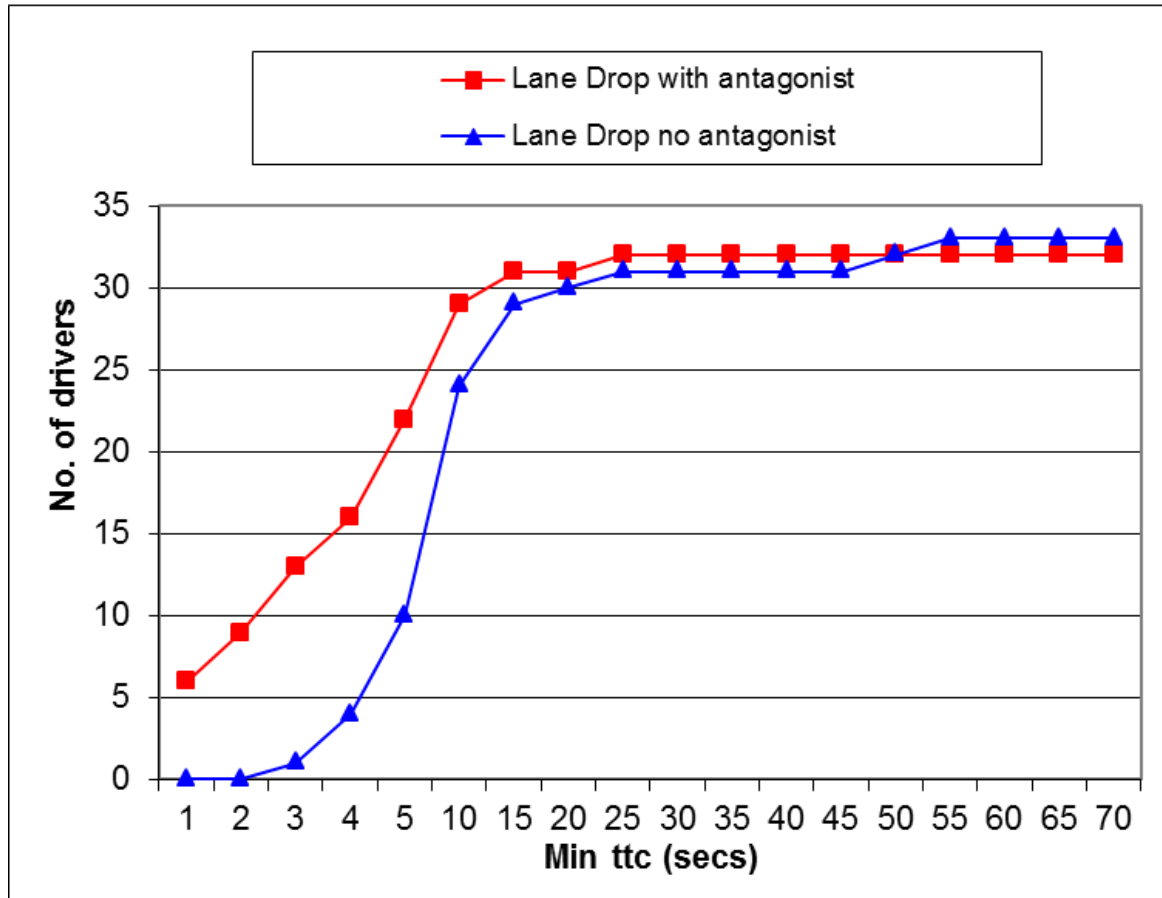
A reminder...

- Can we invoke feelings of anger and anxiety at roadworks in a driving simulator?
- Do these emotions impact on driving behaviour
- Can we reduce these emotions using simple engineering (signage) measures?

Behavioural effects – lane drop



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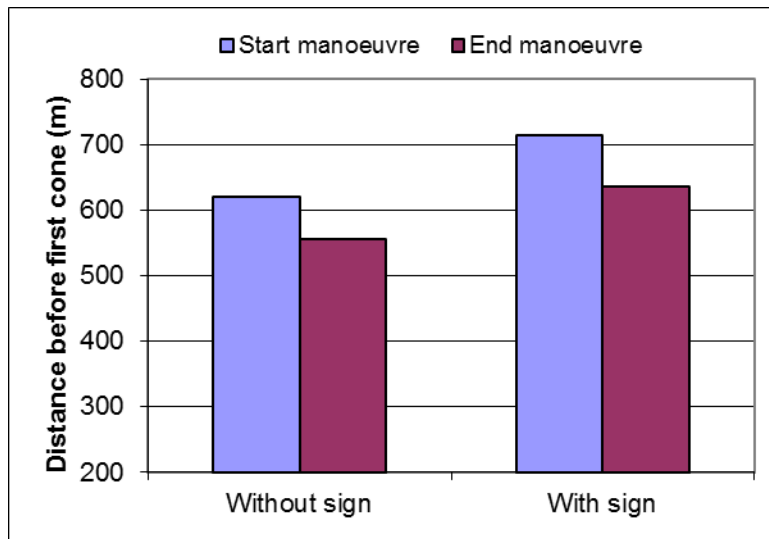
High emotional arousal was followed by smaller ttc's



A reminder...

- Can we invoke feelings of anger and anxiety at roadworks in a driving simulator?
- Do these emotions impact on driving behaviour
- Can we reduce these negative effects using simple engineering (signage) measures?

- Introduced a “Merge in Turn” sign, usually reserved for two-lane roads.



- *Encouraged drivers to move over earlier*
- *Drivers reported that, with the new signage, they would be more inclined to decrease their speed and allow those in lane 3 to merge in front.*
- *If they were travelling in lane 3, they would expect drivers in the middle lane to accommodate them.*

- Driver emotion is affected by experiencing roadworks and the behaviours of other drivers
- This heightened arousal (anger and /or anxiety) can translate into less safe driving behaviour.
- Improving signage can help to alleviate some of these situations

*TTM signs:
Improving their comprehension,
reducing their size*



Samantha Jamson

With support from URS
and the Highways Agency

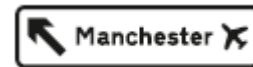
- Reduce size of TTM signs (potential cost savings)
- Maintain or improve levels of driver comprehension
- Increase the efficiency of sign design (common elements)
- Contribute to the Aiming for Zero (AfZ) initiative by improving manual handling aspects

Ergonomic principles for sign comprehension



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- Physical representation – similarity between the content of the sign and reality;
- Conceptual compatibility – extent to which symbols and codes conform to associations;
- Familiarity – the extent to which the driver is familiar with the sign ;
- Standardisation – the extent to which e.g. colour and shape, are consistent for all signs.
- Spatial compatibility – the physical arrangement in space, relative to the position of information and directions;



Circles
give orders



Triangles
warn



Rectangles
inform



ITS

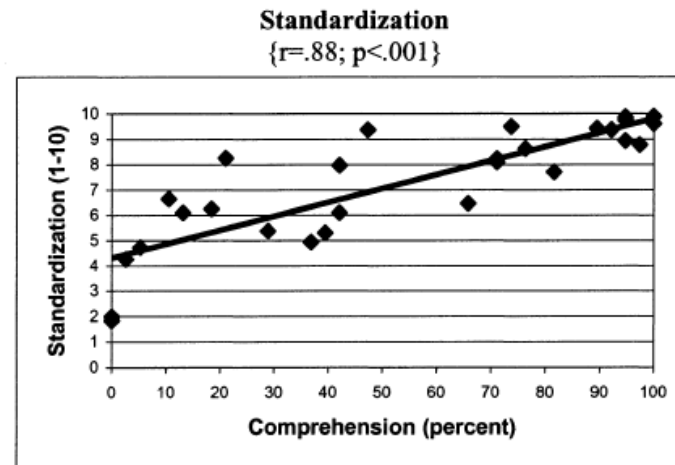
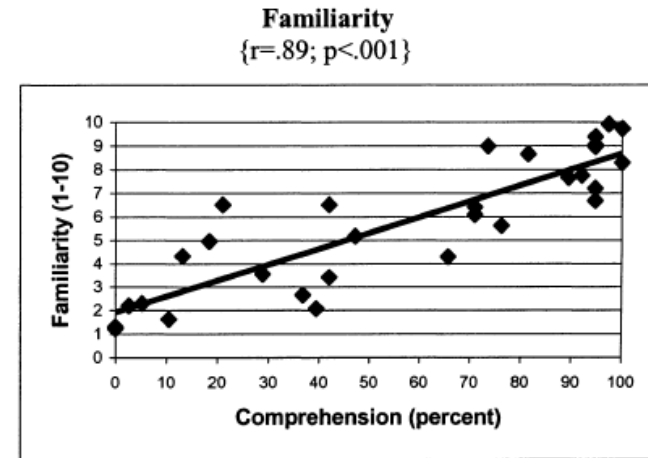
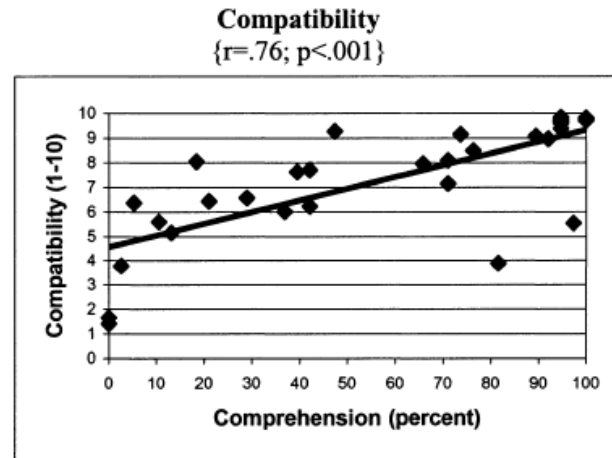
Relationship to comprehension



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- spatial compatibility,
- conceptual compatibility,
- physical representation

- all relate to sign comprehension



Ben-Bassat, T., and Shinar, D., (2006), *Ergonomic Guidelines for Traffic Sign Design Increase Sign Comprehension*, *Human Factors* (48), pp.182-195.

Good and poor adherence



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Blind persons crossing or in the vicinity of the road



Deaf persons crossing or in the vicinity of the road

Example - Contraflow signs



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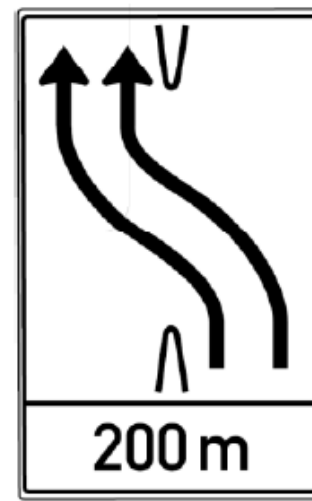
UK



Austria



Czech Republic



Germany



Norway 

Expert Assessment - Results

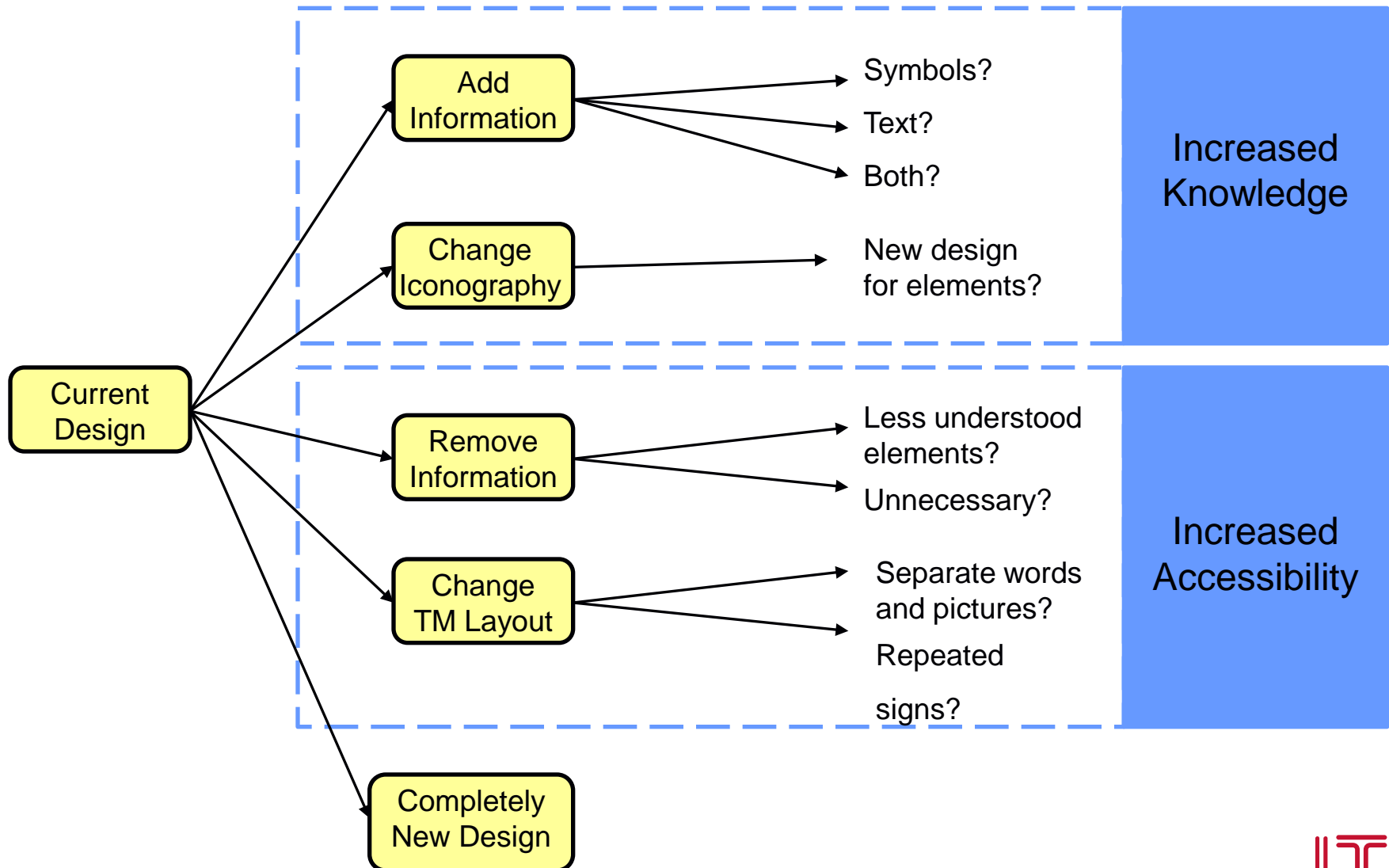


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- Add contraflow lane to RHS of sign
- Alter graphic to show that lane 3 is narrower
- Change 2.0m to 2m looks like 20. Remove ANY VEH and poss change red colour.
- Clarify graphically the number of lanes open on left and right carriageways.
- Could add other road marking info
- Could the full set of lanes of lanes be shown to better communicate the road layout and requirements?
- Could write M1 above each of the narrowed columns.
- Delete ANY VEH and metricate distances
- Delete central reserve and hard shoulder lines. Delete ANY VEH. Reduce size of sign face.
- Don't really need the red area. Would be useful to know how far until the turn off
- Dotted lines to indicate lanes and include hard shoulder line. Remove red areas
- Extend dotted line.
- Improve relative spacing of lanes to better illustrate widths, degrees of movement/freedom.
- Is the red essential? Quite attention grabbing relative to the essential info
- More compact sign face. Split sign into two.
- Not sure red area needed
- Omit red area on bottom right and replace with narrow lane
- Parallel arrows
- Possible inconsistency with the stay in lane and width restriction - if HGV in out side lane should they move over or stay in lane?
- Possibly shallower swoop of arrows from right to left
- Right hand lane section would not be wider
- Smooth corner of red area. Make radii of arrows the same
- Split sign into two - one containing lane restrictions other containing steering inputs/direction



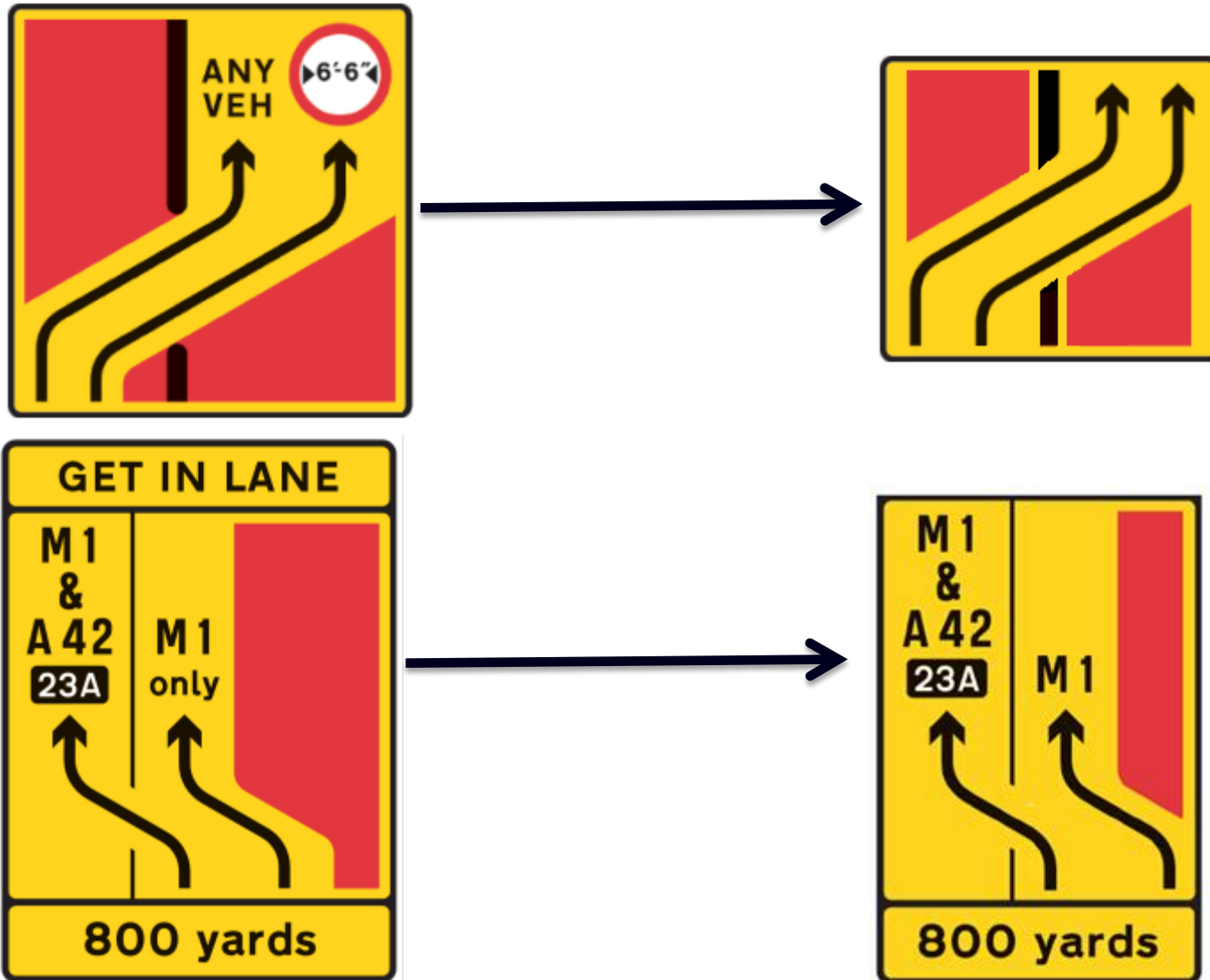
Development Options



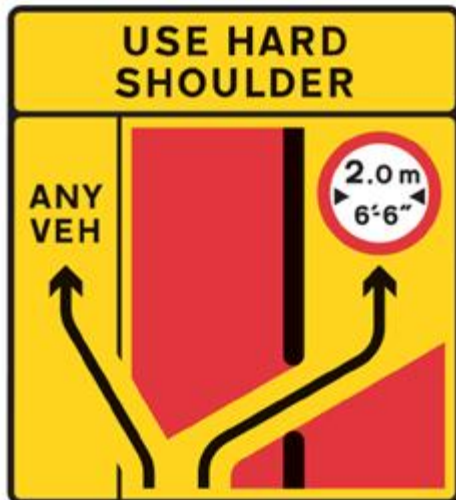
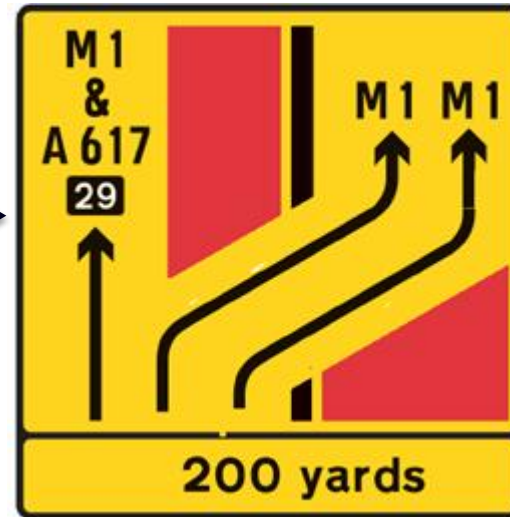
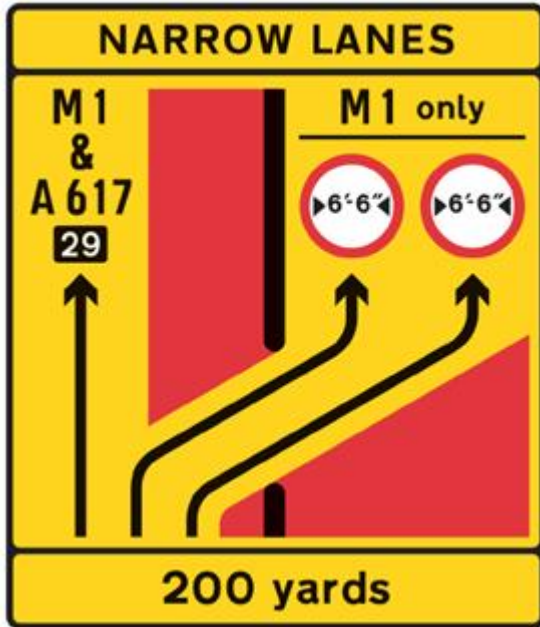
- Examined TSRGD and found that many of the elements or design options could not be applied consistently to all relevant signs.
- This narrowed down the design options considerably, to:
 - Maintain black lines and red areas;
 - Reduce the size of the red areas;
 - Introduce a yellow space between the red areas and black lines;
 - Have lane width that is conceptually correct;
 - Use standard arrow construction;
 - Use angular finish to the central reserve.



Example signs...



Example signs...





Current testing and conclusions

- Comparing Chapter 8 signing with revised signing
- Looking to maintain (or improve sign comprehension)
- Improve worker safety and comfort
- Methodologies:
 - Variety is good
 - Opinion can guide evaluation, but should not influence it
 - Objective data requires sensitive and sensible interpretation